

LISTING OF THE CLAIMS

This listing of claims, amended as indicated below, replaces all prior versions, and listings, of claims in the application

1. (Canceled)

2. (Previously Presented) An apparatus as claimed in claim 40, wherein:

said holding site is configured to hold said target object with a surface thereof substantially at a predetermined orientation; and

said illumination is incident upon said portion of the site substantially normal to said orientation.

3. (Previously Presented) An apparatus as claimed in claim 40, further including a beam splitter, wherein light from said source travels through the beam splitter to illuminate said portion of the holding site, and light reflected by the target object is further reflected by the beam splitter, toward the light detector.

4. (Previously Presented) An apparatus as claimed in claim 40, further including a beam splitter, wherein light from said source is reflected by said beam splitter toward said portion of said site and said light reflected by the target object travels through the beam splitter to the light detector.

5. (Previously Presented) An apparatus as claimed in claim 40, wherein the light detector is an image sensor or a power sensor.

6. (Canceled)

7. (Previously Presented) An apparatus as claimed in claim 40, wherein the light is visible radiation.

8. (Previously Presented) An apparatus as claimed in claim 40, wherein light from the source is collimated or focused into a beam for illuminating said portion of the holding site.

9. (Previously Presented) An apparatus as claimed in claim 8, wherein the illuminating beam is approximately 0.02 to 0.5 mm wide at said portion of the holding site.

10-11. (Canceled)

12. (Previously Presented) An apparatus as claimed in claim 40, wherein the target object is substantially transparent.

13. (Previously Presented) An apparatus as claimed in claim 40, wherein the target object has a refractive index not equal to 1.

14. (Previously Presented) An apparatus as claimed in claim 13, wherein the refractive index of the target is approximately 1.55.

15. (Previously Presented) An apparatus as claimed in claim 40, wherein either or both of the source of light and the light detector are located remotely from the collet.

16. (Previously Presented) An apparatus as claimed in claim 15, including a device to direct light between either or both of the source of light and the light detector and the holding site that is selected from the group consisting of optical fibers, mirrors and light guides.

17-19. (Canceled)

20. (Previously Presented) A method as claimed in claim 45, further including the steps of: passing said illuminating light through a beam splitter to illuminate said portion of the site, and

further reflecting said light reflected by the target object, by the beam splitter, toward the light detector.

21. (Previously Presented) A method as claimed in claim 45, further including the steps of: reflecting said illuminating light from a source toward said portion of said site, by a beam splitter, and passing said light reflected by the target object through the beam splitter to the light detector.

22-24. (Canceled)

25. (Previously Presented) A method as claimed in claim 45, including the further step of: collimating or focusing the illuminating light into a beam for illuminating said portion of the holding site.

26. (Previously Presented) A method as claimed in claim 25, wherein the collimated or focused illuminating beam is approximately 0.02 to 0.5 mm wide at said portion of the holding site.

27. (Previously Presented) A method as claimed in claim 45, wherein the detection of said reflected illuminated light is performed against a dark background.

28. (Previously Presented) A method as claimed in claim 45, wherein the target object is substantially transparent.

29. (Previously Presented) A method as claimed in claim 45, wherein the target object has a refractive index that is not equal to 1.

30. (Previously Presented) A method as claimed in claim 45, wherein the target object has a refractive index of approximately 1.55.

31. (Canceled)

32. (Previously Presented) A method as claimed in claim 47, wherein the detection of light reflected from the holding site is made against a dark background.

33. (Canceled)

34. (Previously Presented) A method as claimed in claim 47, wherein at least one of the source of the illumination and the detector move in tandem with the collet assembly.

35. (Previously Presented) A method as claimed in claim 47, wherein at least one of the source of the illumination and the detector is integral with the collet assembly.

36. (Canceled)

37. (Previously Presented) An apparatus as claimed in claim 40, wherein at least one of the light source and the detector move in tandem with the collet assembly.

38. (Previously Presented) An apparatus as claimed in claim 40, wherein at least one of the light source and the detector is integral with the collet assembly.

39. (Canceled)

40. (Previously Presented) A collet assembly comprising:
a collet having a holding site thereon, wherein the collet is operable to pick up a target object at a first location and to hold the target object on the holding site, and is adapted to be moved from the first location to a second location to which the target object is to be transported, and to deposit the target object at the second location; and
an apparatus for detecting the presence or absence of the target object at the holding site comprising:
a source of light for illuminating at least a portion of the holding site; and

a light detector for receiving illuminating light reflected from the target object if it is present at the holding site,
wherein at least one of the light from the light source and the light received by the detector moves with the collet while the collet moves from the first to the second location.

41. (Previously Presented) Apparatus as claimed in claim 40, wherein the detection of the presence or absence of the target object at the holding site is performed at a third location between the first and second locations.

42. (Previously Presented) Apparatus as claimed in claim 41, further including a dark background at the third location against which the detection of the presence or absence of the target object at the holding site is performed.

43. (Currently Amended) ~~An object handling apparatus~~ Apparatus including, in combination:
a collet assembly as defined in claim 40, operable to pick up, hold, transport and deposit a target object; and
a mechanism operable to move the collet from the first to the second location.

44. (Currently Amended) ~~A die handling apparatus~~ Apparatus including, in combination:
a collet assembly as defined in claim 40, operable to pick up, hold, transport and deposit a die as the target object; and
a mechanism operable to move the collet from the first to the second location.

45. (Previously Presented) A method for determining the presence or absence of a target object at a holding site on a collet assembly, the collet assembly including collet which is operable to pick up the target object at a first location and to hold the target object at the holding site, and which is adapted to be moved from the first location to a second location to which the target object is to be transported, and to deposit the target object at the second location, the method comprising the steps of:

illuminating at least a portion of the holding site;
arranging a light detector to receive illuminating light reflected from the target object if it is present at the holding site and to provide an output representative of the reflected light; and
determining the presence or absence of the target object at the holding site on the basis of the detector output,
wherein at least one of the illuminating light and the light received by the detector moves with the collet when the collet is moved from the first to the second location.

46. (Previously Presented) A method as claimed in claim 45, wherein:
the holding site is configured to hold the target object with a surface thereof substantially at a predetermined orientation; and
said illuminating light is incident upon said portion of the site substantially normal to said orientation.

47. (Previously Presented) A method for handling a target object, comprising the steps of:
providing a collet assembly, the collet assembly including a collet which is operable to pick up the target object at a first location and to hold the target object at a holding site thereon, to move from the first location to a second location to which the target object is to be transported, and to deposit the target object at the second location:
providing a light source operable to illuminate at least a portion of the holding site;
arranging a light detector to receive illuminating light reflected from the target object if it is present at the holding site;
making an attempt to pick up the target object at the first location with the collet;
then moving the collet from the first to the second location;
moving at least one of the light provided by the light source and the light received by the detector with the collet while the collet is moved from the first to the second location; and
detecting the presence or absence of the target object at the holding site by:
illuminating the holding site with light from the light source after the attempt has been made to pick up the target object and detecting any light received by said detector resulting from said illumination; and

making a determination of the presence or absence of the target object at the holding site based on an output signal from the detector.

48. (Previously Presented) A method as claimed in claim 47, wherein the determination of the presence or absence of the target object at the holding site is made by comparing the detector output against a stored reference value representing the absence of the target object.

49. (Previously Presented) A method as claimed in claim 47, further including the step of: moving the collet to the second location and attempting to deposit the target object at the second location if it has been detected at the holding site; or making another attempt to pick up the target object at the first location if it has not been detected at the holding site.

50. (Previously Presented) A method as claimed in claim 48, wherein:
after the attempt to deposit the target object at the second location, the step of detecting the presence or absence of the target object at the holding site is repeated; and
if the target object is detected at the holding site, making another attempt to deposit the target object at the second location; or
if the target object is not detected at the holding site, making an attempt to pick up another target object at the first location.

51. (Previously Presented) A method as claimed in claim 50, wherein:
the determination of the presence or absence of the target object at the holding site is made by comparing the detector output against a stored reference value representing the absence of the target object; and
after the step of detecting the presence or absence of the target object at the holding site has been repeated, if the target object is not detected at the holding site, substituting data representing the output of the detector for the repeated detection step for the stored data before making the attempt to pick up another target object at the first location.

52. (Previously Presented) A method as claimed in claim 51, wherein the detection step is performed at a location between the first and second locations.

53. (Previously Presented) A method as claimed in claim 47, wherein the detection step is performed at a location between the first and second locations.

54. (Previously Presented) A method as claimed in claim 53, wherein the detection step is performed against a dark background.